



UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024**

- COURSE NAME : VEHICLE STRUCTURE
- COURSE CODE : BNG 30103
- PROGRAMME CODE : BNG
- EXAMINATION DATE : JULY 2024
- DURATION : 2 HOURS 30 MINUTES
- INSTRUCTIONS :
1. ANSWER **ALL** QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA
 - Open book
 - Closed book
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

- Q1** Vehicle structures are crucial for ensuring safety and performance. Fundamental vehicle loads include static loads, dynamic loads, and environmental loads (wind, road conditions). Estimating these loads accurately is essential for designing vehicles that are safe and reliable.
- (a) Imagine you are a lead engineer at an automotive design firm tasked with developing a new vehicle model. Your team is considering the use of Simple Structural Surface (SSS) in the vehicle's body design. Explain **THREE (3)** aspects of incorporating SSS into the design.
(6 marks)
- (b) As an engineering technologist specializing in automotive structure design, you are tasked with evaluating the importance of the conceptual design stage in the development of a new vehicle model. Elaborate **THREE (3)** aspects of the conceptual design stage.
(6 marks)
- (c) Discuss how instantaneous overload and fatigue damage affect vehicle structural dynamics, specifically their impact on vehicle components.
(8 marks)
- (d) Vehicle structures are subjected to various loads during their lifetime, which are essential to consider in their design. List out **FIVE (5)** basic global load cases.
(5 marks)
- Q2** Vehicle structures encompass various designs, each offering unique strengths. The Simple Structural Surface (SSS) method is a modeling technique used in vehicle engineering for load-path and stiffness analysis. It simplifies complex structures into basic surfaces, aiding in analyzing load paths and stress distribution.
- (a) Strength and stiffness are two critical terminologies in vehicle structure design. In detail, differentiate between these two requirements.
(6 marks)
- (b) Automotive structures vary, some with separate chassis and body, others with integrated chassis and body, each offering unique strengths and weaknesses. Briefly explain **FOUR (4)** types of automotive structure.
(8 marks)
- (c) Simple Structural Surface (SSS) is a basic structural model used in vehicle engineering to simplify the analysis of load paths and stress distribution in vehicle bodies, aiding in design optimization. By using aid of illustration, sketch and explain **TWO (2)** types of SSS.
(6 marks)

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- (d) As an engineering technologist specializing in vehicle structures, you are tasked with identifying and addressing issues related to the use of the Simple Structural Surface (SSS) method in load-path and stiffness analysis. Discuss the main role of this method.

(5 marks)

Q3 Vehicle structures are crucial for ensuring safety and performance. Fundamental vehicle loads include static loads, dynamic loads, and environmental loads (wind, road conditions). Estimating these loads accurately is essential for designing vehicles that are safe and reliable. Therefore, application of SSS methods to an existing vehicle structure is very important.

- (a) The Simple Structural Surface (SSS) method is applied in vehicle engineering to analyze and optimize vehicle structures. It simplifies complex structures into simpler forms to ensure structural integrity and performance in vehicles.

- (i) State **THREE (3)** objectives for using the SSS method to analyze an existing vehicle structure.

(3 marks)

- (ii) Identify **FOUR (4)** critical dimensions for idealizing the SSS outline from basic vehicle dimensions.

(4 marks)

- (iii) Explain the implication of bending case design.

(6 marks)

- (b) Evaluate the effectiveness of the SSS method in analyzing the critical areas of a vehicle structure such as the front suspension, engine rails, main torsion box and torsion case edge loads.

(6 marks)

- (c) Discuss how the analysis of shear forces, bending moments and stress distributions can provide valuable insights for improving the structural design.

(6 marks)

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- Q4** Fundamental and Preliminary Design SSS Method is an engineering approach applied in vehicle design to ensure optimal structural integrity, performance, and safety. This method helps engineers optimize designs, considering factors like weight, cost, manufacturability, and regulatory requirements. Integration with Finite Element Analysis (FEA) enhances the accuracy and efficiency of design validation. Overall, the SSS method is crucial for developing robust and reliable vehicle structures.
- (a) Explain the fundamental principles underlying the SSS design synthesis approach in vehicle engineering, providing examples to illustrate each principle.
(9 marks)
- (b) Discuss the significance of the relationship between the SSS method and Finite Element Analysis (FEA) in the preliminary design phase of vehicle structures. Provide examples to support your explanation.
(8 marks)
- (c) Explain how the SSS method is utilized in the preliminary design and analysis of body subassemblies in vehicle engineering, highlighting its significance in optimizing structural performance.
(8 marks)

- END OF QUESTIONS -

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